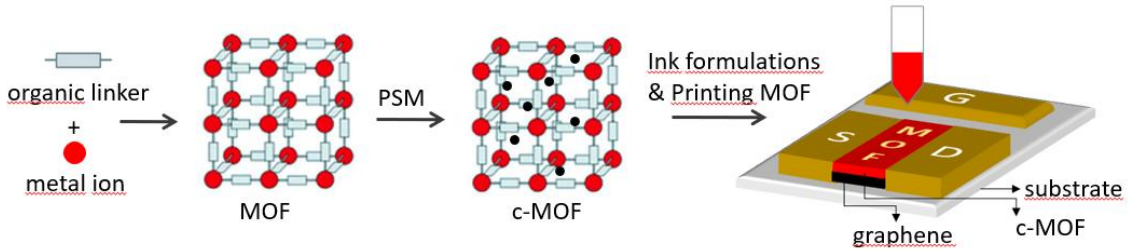
Bachelor Thesis / HiWi (Wissenschaftliche Hilfskraft)
Institute of Nanotechnology (INT) – KIT Campus North
Students of chemistry, physics, materials science, electrical engineering
Posted on: 27.04.2026

Development of MOF-Inks for Printed Electrolyte-Gated Transistors

Metal-Organic Frameworks (MOFs) are microporous crystalline coordination polymers with the largest surface area of any materials known. MOFs, as unique class of porous systems have been recognised by prestigious Nobel Prize 2025. Owing to their ultrahigh (Brunauer–Emmett–Teller (BET) ≥ 6000 m^2 g^{-1}) surface areas with permanent porosity, tunable pore sizes, and chemical diversity, these materials show tremendous properties for diverse applications. In this vein, translation of MOFs from research to industry remains constrained, in part due to difficulties in shaping and handling the polycrystalline powders. Additive manufacturing offers a powerful and versatile approach to shape MOFs into targeted forms with well reserved intrinsic functions. Efficient methods to deposit MOFs are needed to integrate these microporous materials into printed electronic devices.



Scheme 1: Overview MOF synthesis, post-synthetic modifications (PSM), ink formulations to MOF printing

This project aims development of MOF based ink formulations primarily to be optimized for ultrasonic printing by using “Sonoplot Microplotter System” that is suitable for printing electronic devices on microscale architectures. In terms of printing methods, it is planned to investigate further inkjet printing possibilities depending on the achievable ink parameters, critically reaching required particle sizes while maintaining structural integrity and porosity. The major focus for Bachelor thesis / HiWi student would be development of MOF-based ink formulations suitable for microprinting. Student will be involved in synthesis of MOF materials and optimization of MOF-based ink formulations and printing of transistor´s micro-channels of different sizes (30, 50 and 70 µm) in geometries including single channel and interdigitate electrodes. Student will carry research tasks in close supervision and will get hands-on-experience in an interdisciplinary research field in a dynamic research environment.

Tasks:

- Hydro/solvothermal synthesis and characterization of literature known MOFs
- Post-functionalization of MOFs (insulator to conducting MOFs)
- Optimization of MOF ink formulations
- Printing of developed MOF inks (transistor´s micro-channels)
- Electrical characterization of printed transistors using a probe station

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